

Application No. 10/594,652
Amendment Dated: January 7, 2010
Reply to Office Action Dated October 7, 2009

Remarks

Claims 1-31 are pending.

Claims 1-31 stand rejected.

Claim 1 is amended.

Claim 2 has been cancelled.

Claims 1 and 3-31 are submitted herein for review.

No new matter has been added.

In the Office Action, the Examiner has rejected independent claim 1 under 35 U.S.C. § 103(a) as being unpatentable over Tsukuda et al. (U.S. Patent No. 6,946,029). Applicant respectfully disagrees and submits the following remarks in response.

The present independent claim 1 is directed to a method of fabricating at least one polycrystalline silicon plate with one of its two faces presenting predetermined relief. The method includes depositing a layer of polycrystalline silicon on at least one of the two faces of a support, the support being a carbon tape. The face of the support is embossed to impart thereto a shape that is complementary to the relief. The polycrystalline silicon layer is deposited on the embossed face of the support, the surface of the polycrystalline silicon layer situated in contact with the embossed face then taking on the shape of the relief. The polycrystalline silicon layer is cut up and the support is eliminated in order to obtain the polycrystalline silicon plate.

Such a method is employed in the textturing of polycrystalline silicon plates used in photovoltaic applications. The process of texturing is important for maintaining high conversion efficiencies when it is desired to reduce drastically the thickness of the silicon layer typically from around 300 micrometers (μm) or 350 μm (conventional photovoltaic cells), down to less

than 100 μm , or down to 50 μm (or even less), in order to reduce the cost of such devices. In this range, and while the coefficient of reflection on the rear face is typically less than 0.6 (normal incidence on the rear face), a large fraction of the spectrum of the incident radiation propagating close to the normal at the surface is not absorbed in the thickness of the material unless special precautions are taken.

The present arrangement allows for texturing polycrystalline silicon layers in order to fabricate solar cells, and is particularly advantageous for layers of small thickness, less than 300 μm . Texturing consists in imparting predetermined relief to the surface of the layer, for example an array of parallel grooves or an array of pyramids.

The prior art techniques present limitations that are severe, either in terms of cost (electrochemical etching, plasma etching, and mechanical etching), or in terms of effectiveness (acid chemical etching). Several of them are not applicable to plates that are very thin, of thickness smaller than 300 μm , which are generally very fragile, given the manipulations and/or the mechanical stresses they involve. That applies to mechanical etching and to some extent to electrochemical cleaning (manipulations). The method of the present claim 1 does not present the above drawbacks. See paragraphs [0007] – [0013].

Moreover, the presently claimed arrangement reinforces the stiffness of thin silicon plates. The present invention solves the problem of embossing polycrystalline silicon plates, in particular of small thickness, less than 300 μm , by using a method that is less expensive than prior art methods, and effective since it does not disturb the internal structure of the silicon, and since it can be implemented industrially. See paragraphs [0014] – [0015].

The cited Tsukuda reference describes a silicon sheet (40) produced from a base (1) with protrusions (2) (See for example, Fig. 1, and col. 16, lines 28-30). This base is a cooling roller

(32), which is dipped into a silicon melt to form the silicon sheet on its surface (See col.17, lines 8-9). The curved protrusions are formed only on one side of the silicon sheet as seen in Figure 34. Thus, Tsukuda discloses a completely different manufacturing method as the one claimed in the claim 1.

For example, Tsukuda describes that the layer of silicon is deposited on the cooling roller surface, and then the sheet of silicon is pulled -- (See figure 34), whereas in the present arrangement, the layer of polycrystalline silicon is deposited on at least one face of a carbon tape. Moreover, in Tsukuda the silicon sheet which is embossed whereas in the present arrangement the carbon tape is embossed. Additionally, in Tsukuda the silicon sheet is only deposited on the cooling roller surface whereas in the present arrangement, the silicon layer is deposited on the embossed face of the carbon tape and then the carbon tape is ultimately eliminated.

Applicant notes that the Examiner also cited to the Belouet (EP0079567) reference in support of the rejection of several dependent claims. This Belouet reference does describe a manufacturing method of at least one polycrystalline silicone plate using a carbon tape support. However, in the present arrangement, the face of the carbon tape is embossed to impart to it a shape that is complementary to the relief. Also, in the present arrangement, the polycrystalline silicon layer is deposited on the embossed face of the carbon tape, the surface of the polycrystalline silicon layer situated in contact with the embossed face then takes on the shape of the relief. The Belouet reference does not describe these features.

As such, Applicant respectfully submits that neither of the cited prior art references describe the features as claimed in claim 1. For Example, neither Tsukuda nor Belouet describe depositing a layer of polycrystalline silicon on at least one of the two faces of a support, the support being a carbon tape where the face of the support is embossed to impart thereto a shape

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that is complementary to said relief. Likewise, neither Tsukuda nor Belouet describe depositing the polycrystalline silicon layer on the embossed face of the support, the surface of the polycrystalline silicon layer situated in contact with the embossed face then taking on the shape of the relief.

For at least these reasons, Applicant submits that the prior art does not show all of the elements of claim 1 and respectfully requests that the rejection be withdrawn. As claims 3-31 depend from claim 1, the rejection of these claims should be withdrawn for at least the same reasons.

In view of the foregoing, Applicant respectfully submits that pending claims 1 and 3-31 are in condition for allowance, the earliest possible notice of which is earnestly solicited. If the Examiner feels that an interview would facilitate the prosecution of this Application he is invited to contact the undersigned at the number listed below.

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Respectfully submitted,

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